WAFER RING SUPPLY AND RETURN DEVICE

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ABSTRACT
A device for conveying a wafer ring between a wafer ring container and a pellet pick-up device. The wafer ring having a wafer sheet with semiconductor pellets adhered on it is held at its one end by a pair of claws that is equipped with a sensor for detecting the wafer ring held by the claws. After determining the presence of the wafer ring held by the pair of claws, the claws carry the wafer ring onto the pellet pick-up device and then carries the wafer ring back to the wafer ring container. The sensor can be installed on either one of the pair of the claws.

5 Claims, 5 Drawing Sheets
WAfer Ring SUPpLy AND RETURN DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention
The present invention relates to wafer ring supply and return device.

2. Prior Art

This device includes: a wafer ring cassette that accommodates wafer rings at a predetermined pitch, an elevator device which raises and lowers the wafer ring cassette, a wafer ring conveying means which conveys wafer rings one at a time from the wafer ring cassette and transfers the wafer rings onto a pellet pick-up device and then returns used wafer rings from which the semiconductor pellets have been removed to empty wafer ring accommodating sections of the wafer ring cassette, and a pair of guide rails which guide both side edges of the wafer rings conveyed by the wafer ring conveying means.

The wafer rings used in this device include wafer sheets which are attached at their circumferential areas to the wafer rings, and semiconductor pellets are arranged in the X and Y directions on the wafer sheets and passed thereto.

Wafer rings accommodated in the wafer ring cassette are conveyed while they are held by upper and lower claws of the wafer ring conveying means and then supplied to the pellet pick-up device. The used wafer rings from which the semiconductor pellets have been picked up by the pellet pick-up device are again conveyed while they are held by the upper and lower claws of the wafer ring conveying means and returned to an empty wafer ring accommodating section of the wafer ring cassette.

In such a wafer ring supply and return device as described above, there is potential danger of an erroneous conveying operation when:

- the wafer ring is not securely held by the upper and lower claws,
- the wafer ring slips out of the upper and lower claws while the ring is being conveyed,
- the upper and lower claws do not open properly, and the upper and lower claws move away from the pellet pick-up device without releasing the wafer ring onto the pellet pick-up device, and
- one of the plurality of wafer ring accommodating sections of the wafer ring cassette contains no wafer ring to be transferred, which often occurs.

In the prior art described above, no consideration is given to a solution of the erroneous operations as described above. Accordingly, in order to check whether or not a wafer ring has been conveyed, wafer ring detection sensors must be installed in various locations such as the accommodating openings of the wafer ring cassette, intermediate points on the conveying path between the wafer ring cassette and the pellet pick-up device, in the pellet pick-up device, and in positions where the upper and lower claws are moved away from the pellet pick-up device, etc. However, it is not preferable to use an extremely large number of sensors.

SUMMARY OF THE INVENTION

Accordingly, the object of the present invention is to provide a wafer ring supply and return device which requires as small number of sensor devices as possible and is capable of instant and reliable detection of erroneous conveying. The object of the present invention is accomplished by a unique structure for a wafer ring supply and return device which comprises:

- a wafer ring cassette in which wafer rings with adhesively attached wafer sheets to which pellets are pasted are accommodated,
- an elevator device which raises and lowers the wafer ring cassette,
- a wafer ring conveying means which includes upper and lower claws for holding a part of each of the wafer rings, the conveying means conveying wafer rings one at a time from the wafer ring cassette to a pellet pick-up device and then returning used wafer rings from which semiconductor pellets have been removed to the wafer ring cassette, and
- a sensor installed on either the upper claw or the lower claw of the wafer ring conveying means so as to detect the wafer rings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partially sectional front view which illustrates one embodiment of the wafer ring supply and return device of the present invention;

FIG. 2 is a top view thereof;

FIG. 3 illustrates the upper and lower claws that hold the wafer rings, in which FIG. 3(a) is a partially sectional front view, and FIG. 3(b) is a bottom view;

FIG. 4 shows the wafer ring guide means with the guide rails in a horizontal state, in which FIG. 4(a) is a top view, FIG. 4(b) is a front view, and FIG. 4(c) is a right-side view;

FIG. 5 shows the wafer ring guide means with the guide rails in a vertical state; in which FIG. 5(a) is a top view, FIG. 5(b) is a front view, and FIG. 5(c) is a right-side view.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A preferred embodiment of the present invention will be described with reference to FIGS. 1 through 5.

In essence, according to the preferred embodiment of the present invention, an upper claw 45 and a lower claw 46 which mutually hold wafer rings 1 in between are installed in a wafer ring conveying means 35 that conveys wafer rings 1 from a wafer ring cassette 10 to a pellet pick-up device 20 and from the pellet pick-up device 20 back to the wafer ring cassette 10; and a fiber sensor 47 which detects the presence or absence of a wafer ring 1 is installed on the upper claw 45. The fiber sensor 47 can be installed on the lower claw 46.

First of all, as shown in FIGS. 1 and 2, each one of the wafer rings 1 that is handled by the device of the preferred embodiment of the present invention includes a wafer sheet 2. In other words, the outer circumferential portions of wafer sheet 2 is attached to the wafer ring 1, and a plurality of semiconductor pellets 3 are arranged in the X and Y directions and pasted on this wafer sheet 2.

The device of the preferred embodiment includes:

- a wafer ring cassette 10 which accommodates the wafer rings 1,
- an elevator device 13 which raises and lowers the wafer ring cassette 10,
- a pusher means 16 which pushes wafer rings 1 out of the wafer ring cassette 10,
a pellet pick-up device which is installed at a fixed distance from the wafer ring cassette 10 so as to be located adjacent to the accommodating openings 11 of the wafer ring cassette 10.

A wafer ring conveying means 35 which conveys unused wafer rings 1 to the pellet pick-up device 20 and then returns used wafer rings 1, from which the semiconductor pellets 3 have been removed, to empty wafer ring accommodating sections 12 formed in the wafer ring cassette 10, and

A wafer ring guide means 65 which guides the wafer rings 1 when the wafer rings 1 are being conveyed by the wafer ring conveying means 35.

The structures of these elements will be described below in detail.

The structures of the wafer ring cassette 10, elevator device 13 and pusher means 16 will be described first. These elements (the wafer ring cassette 10, elevator device 13 and pusher means 16) have conventional universally known structures and will be described briefly.

The wafer ring cassette 10 has a plurality of wafer ring accommodating sections 12 which are positioned at a prescribed pitch in the vertical direction (or Z direction), and a wafer ring 1 is accommodated in each of these wafer ring accommodating sections 12.

The elevator device 13 has an elevator 14, and the wafer ring cassette 10 is provided on this elevator 14. The elevator 14 is screw-engaged with a screw shaft 15 which is rotated by a motor (not shown). When the motor is actuated, the elevator 14 is moved upward and downward.

The pusher means 16 is an air cylinder and is positioned at the wafer ring conveying level 17 in the Z direction. The pusher means 16 pushes the wafer rings 1 out of the wafer ring cassette 10 by operating the rod 16 of the air cylinder.

Next, the pellet pick-up device 20 will be described. This device also has a conventionally known structure, and the description thereof will be brief.

An XY table 22 which is driven in the X and Y directions is installed on a base plate 21, and a supporting plate 23 is provided above this XY table 22. The supporting plate 23 is movable in a vertical direction. A wafer ring supporting ring 24 which has an annular cylindrical wall 24a is installed on the supporting plate 23. The annular cylindrical wall 24a is smaller in size than the wafer rings 1.

A chuck ring 25 which is driven upward and downward (i.e., in the Z direction) by a vertical driving means (not shown) is installed above the wafer ring supporting ring 24.

A suction chucking nozzle 27, which is moved in the Z direction and in the X and Y directions by a vertical driving means (not shown) and an XY table 22, is installed above the pick-up position 26. A needle 28 which is moved in the Z direction by a vertical driving means (not shown) is installed beneath the pick-up position 26.

Next, the structure of the wafer ring conveying means 35 will be described.

Supporting plates 36 and 37 are provided on both ends of the base plate 21, and a guide rail 38 which extends in the X direction is secured to the upper end portions of the supporting plates 36 and 37. A slider 39 is fitted over the guide rail 38 so that the slider 39 slides on this guide rail 38, and a supporting rod 40 which extends upward is provided on the slider 39 in a vertically movable fashion. A supporting block 41 is mounted on the upper end portion of the supporting rod 40, and a supporting rod 42 which extends in the Y direction is fastened to the upper end portion of the supporting block 41.

A claw holder 43 is provided on the tip end portion of the supporting rod 41, and an air cylinder 44 is mounted on this claw holder 43 as shown in FIG. 3. An upper claw 45 is coupled to the operating rod 44 of the air cylinder 44, and a lower claw 46 is fastened to the claw holder 43 so as to face the undersurface of the upper claw 45. Thus, when the air cylinder 44 is actuated and the supporting rod 41 is moved out of the air cylinder 44, the upper claw 45 is moved downward in FIG. 3(a) and comes into contact and engages with the lower claw 46 so as to hold an object in between.

A fiber sensor 47 is attached to the holding section 45a of the upper claw 45. A groove 46a is formed in one section of the lower claw 46 that faces the holding section 45a. The sensor 47 can be mounted on the lower claw 46.

As seen from FIG. 1, a pulley shaft 50 is rotatably provided on the supporting plate 36 so as to be located beneath the guide rail 38, and two pulleys 51 and 52 are coupled to both ends of this pulley shaft 50. Another pulley shaft 53 is rotatably provided on the supporting plate 37 so as to be parallel to the pulley shaft 50, and a pulley 54 is coupled to this pulley shaft 53 so that the pulley 54 faces the pulley 51. A motor 55 is mounted on the base plate 21, and a pulley 56 is coupled to the output shaft of the motor 55. An endless belt 57 is provided on the pulleys 51, 54 and 56, and the slider 39 is connected to the upper portion of the endless belt 57. A drive belt 58 is mounted on the pulleys 52 and 56. Thus, when the motor 55 is actuated, the endless belt 57 is rotated, and therefore, the slider 39 connected to the endless belt 57 is moved by this belt 57.

The structure of the wafer ring guide means 65 will be described with reference to FIGS. 1 through 5, especially to FIGS. 4 and 5.

A vertical frame 66 is installed on the wafer ring cassette 10 so as to face the pellet pick-up device 20. A rotary shaft 67 which extends in the Y direction at a point slightly lower than the wafer ring conveying level 17 is rotatably supported on the upper end portion of the frame 66, and a guide rail supporting plate 68 is fastened to this rotary shaft 67.

A pair of guide rails 69 and 70 which guide both side edges of the wafer rings 1 with their guide grooves 69a and 70a are secured to the (upper) surface 68 of the guide rail supporting plate 68. Here, an arrangement is made so that the guide grooves 69a and 70a of the guide rails 69 and 70 are positioned at the wafer ring conveying level 17 (the surfaces of the guide grooves 69a and 70a are flush with the conveying level 17) when the guide rails 69 and 70 are put into a horizontal position as shown in FIG. 1 and FIG. 4(b).

A crank lever 71 is connected to the end of the rotary shaft 67 that projects over the side plate 66a (see FIG. 5(a)). An air cylinder supporting block 72 is secured to the lower end of the side plate 66a, and an air cylinder 73 is mounted on the air cylinder supporting block 72 so that the air cylinder 73 is pivotable. A linking member 74 is coupled to the operating rod 73a of the air cylinder 73, and the linking member 74 is rotatably linked to the crank lever 71.

Next, the operation of the above embodiment will be described.

When the screw shaft 15 of the elevator device 13 rotates, the elevator 14 and wafer ring cassette 10 are moved upward and downward; and a corresponding wafer ring accommodating section 12 of the wafer ring cassette 10 is positioned at the wafer ring conveying level 17. At this point, the guide rails 69 and 70 of the wafer ring conveying means 65 are in a horizontal position.

With the upper claw 45 provided on the claw holder 43 opened (the upper and lower claws 45 and 46 being
separated), the slider 39 of the wafer ring conveying means 35 is positioned near the wafer ring cassette 10 (at the left end of the guide rail 38 in FIG. 1) so that the upper claw 45 is positioned above the wafer ring 1 to be taken out.

Then, the pusher means 16 is actuated so that the operating rod 16a advances (toward the right in FIG. 1), thus pushing the wafer ring 1 out of the wafer ring cassette 10 so that the wafer ring 1 is fed into the space between the upper claw 45 and the lower claw 46. As a result, the groove 46a formed in the lower claw 46 is blocked by the wafer ring 1, and the light from the fiber sensor 47 is interrupted; as a result, the fiber sensor 47 outputs an “on” signal, which represents the detection of the presence of the wafer ring 1 between the upper and lower claws 45 and 46. Upon this “on” signal, the air cylinder 44 is actuated, and the operating rod 44a of the air cylinder 44 is lowered, thus holding the end portion of the wafer ring 1 between the upper claw 45 and lower claw 46.

Next, the motor 55 is actuated so as to rotate in the forward direction (as indicated by arrow A). As a result, the pulley 56 coupled to the output shaft of the motor 55 causes the endless belt 57 to rotate in the direction indicated by arrow B (i.e., toward the right in FIG. 1) via the driving belt 58, thus causing the slider 39 connected to the belt 57 to move in the same direction B along the guide rail 38. The wafer ring 1 held by the upper and lower claws 45 and 46 which are provided on the slider 39 is conveyed toward the pellet pick-up device 20 while being guided by the pair of guide rails 69 and 70 of the wafer ring conveying means.

When the wafer ring 1 reaches the center position 29 of the wafer ring supporting ring 24 of the pellet pick-up device 20, the rotation of the motor 55 is temporarily stopped.

The air cylinder 44 is actuated so that the operating rod 44a retracts, thus releasing the wafer ring 1 onto the wafer ring supporting ring 24.

Then, the motor 55 is again actuated so as to rotate in the forward direction, so that the upper claw 45 and lower claw 46 are moved to the right of the wafer ring supporting ring 24 as shown by the two-dot chain line in FIG. 1, due to the lowering movement of the supporting rod 40. Thus, the supply of the wafer ring 1 onto the wafer ring supporting ring 24 is completed.

When the wafer ring 1 is placed on the wafer ring supporting ring 24, the air cylinder 73 of the wafer ring guide means 65 is actuated so that the operating rod 73a is retracted. As a result, the crank lever 71 and rotary shaft 67 which are connected to the operating rod 73a via the linking member 74 are pivoted in the direction indicated by arrow C in FIG. 4(b), thus causing the pair of guide rails 69 and 70 to assume a vertical position as shown in FIGS. 5(a) through 5(c) from the horizontal position which is shown in FIGS. 4(a) through 4(c).

When the wafer ring 1 is placed on the wafer ring supporting ring 24 as described above, the wafer ring supporting ring 24 is lowered by a driving means (not shown), so that the wafer ring 1 is moved downward. As a result, the wafer sheet 2 is stretched so that gaps between the plurality of semiconductor pellets 3 pasted on the wafer ring 1 are widened. Then, the XY table 22 is driven so that the (first) semiconductor pellet 3 that is to be picked up is positioned in the pick-up position 26. The needle 28 is raised to push the semiconductor pellet 3 upward, and also the suction chucking nozzle 27 is lowered so that the semiconductor pellet 3 is positioned in the pick-up position 26. The suction holding and picked up. The suction chucking nozzle 27 which thus holds the semiconductor pellet 23 is raised,

moved in the X and Y directions and then lowered, so that the semiconductor pellet 3 is placed in a semiconductor pellet positioning location or bonding position (both not shown). Afterward, the suction chucking nozzle 27 moves back to the pick-up position 26.

When the semiconductor pellet 3 positioned in the pick-up position 26 is thus picked up, the XY table 22 is driven so that the next semiconductor pellet 3 to be picked up is located in the pick-up position 26. The plurality of semiconductor pellets 3 pasted on the wafer sheet 2 are successively picked up by the suction chucking nozzle 17. When all of the semiconductor pellets 3 on the wafer sheet 2 have been picked up, the wafer ring 1 is returned to the wafer ring cassette 10 as a “used wafer ring”.

The used wafer rings returning operation will be described below.

The XY table 22 is driven so that the pellet pick-up device 20 is moved to the initial position, which is the position of the pick-up device 20 when a wafer ring 1 is supplied thereon as described above.

The chuck ring 25 is raised so that the wafer ring 1 is lifted from the wafer ring supporting ring 24.

The air cylinder 73 is actuated in the opposite direction from that described above, so that the operating rod 73a protrudes, thus causing the crank lever 71 and rotary shaft 67 to pivot in the opposite direction from that described above, thus bringing the guide rails 69 and 70 back to assume the horizontal position as shown in FIG. 4.

Then, with the upper claw 45 and lower claw 46 separated, the motor 55 is actuated to rotate in the reverse direction, thus causing the claws 45 and 46 to move toward the left in FIG. 1. As a result, the end portion of the used wafer ring 1 enters in the space between the upper claw 45 and lower claw 46 and is detected by the fiber sensor 47. Then, the operating rod 44a of the air cylinder 44 is lowered (or moved out of the cylinder 44) upon this detection, so that the upper claw 45 holds the wafer ring 1 together with the lower claw 46.

Next, the motor 55 is again actuated so that the slider 39 is moved further toward the left in FIG. 1, thus causing the used wafer ring 1 held by the upper and lower claws 45 and 46 to be returned to an empty wafer ring accommodating section 12 of the wafer ring cassette 10 while being guided by the guide rails 69 and 70.

Afterward, the air cylinder 44 is actuated so that the operating rod 44a is retracted, causing the upper claw 45 to be moved upward and the used wafer ring 1 to be released from the upper and lower claws 45 and 46. The used wafer ring 1 is thus accommodated in the wafer ring accommodating section 12.

When the supply and return of one wafer ring is thus completed, the wafer ring cassette 10 is lowered by one pitch by the elevator 14 of the elevator device 13, so that the next unused wafer ring 1 that is to be supplied to the pellet pick-up device 20 is positioned at the wafer ring conveying level 17.

The supply and return of the all of the wafer rings 1 is executed by repeating the series of the above described operations.

In the embodiment described above, the fiber sensor 47 is installed in the upper claw 45. The fiber sensor 47, however, can be provided on the lower claw 46. In addition, a common reflective type sensor can be used instead of a fiber sensor.

As seen from the above, in the preferred embodiment of the present invention, a fiber sensor is installed in the upper
claw of the wafer ring conveying means that holds and conveys the wafer rings. Accordingly, the erroneous conveying of wafer rings can be immediately detected in cases where no wafer ring is held by the claws, the wafer ring has fallen out of the claws, and the wafer ring is not released from the claws.

As described in detail above, according to the present invention, only one sensor which detects wafer rings is installed in either the upper claw or lower claw of the wafer ring conveying means. Accordingly, it is not necessary to use a number of sensors, and erroneous conveyance of wafer rings can be immediately and reliably detected.

We claim:

1. A wafer ring supply and return device comprising:
   a wafer ring cassette on which wafer rings having wafer sheets with semiconductor pellets adhesively mounted thereon are accommodated at a fixed pitch, an elevator device which raises and lowers said wafer ring cassette, a wafer ring conveying means comprised of upper and lower claws that hold said wafer rings, conveys said wafer rings one at a time from said wafer ring cassette to a pellet pick-up device, and then returns used wafer rings from which said semiconductor pellets have been removed to empty wafer ring accommodating sections of said wafer ring cassette, and
   a sensor means installed on either one of said upper claw and lower claw of said wafer ring conveying means, said sensor means for detecting if no wafer ring is held by said claw, the wafer ring has fallen out of the claws or the wafer ring has not been released from the claws.

2. A wafer ring supply and return device according to claim 1, wherein said wafer ring conveying means is provided with a belt means that is driven by a motor so that said upper and lower claws are moved by said belt means.

3. A wafer ring conveying device which conveys a wafer ring between a wafer ring storing means and a wafer ring supporting means, said device comprising:
   a guide rail provided between said wafer ring storing means and said wafer ring supporting means;
   a sliding means provided on said guide rail, said sliding means being movable on said guide rail so as to be moved between said wafer ring storing means and said wafer ring supporting means;
   a wafer ring holding means provided on said sliding means, said wafer ring holding means holding said wafer ring while said sliding means is moved on said guide rail; and
   a detecting means provided on said wafer ring holding means, said detecting means for detecting if no wafer ring is held by the wafer ring holding means, the wafer ring has fallen out of the wafer ring holding means or the wafer ring has not been released from the wafer ring holding means.

4. A wafer ring conveying device according to claim 3, wherein said wafer ring holding means comprises a pair of claw means which are engageable with each other so as to hold said wafer ring in between, and said detecting means being provided on either one of said claw means.

5. A wafer ring conveying device according to claim 3, further comprising a wafer ring guide means which is provided adjacent to said wafer ring storing means so as to guide said wafer ring when said wafer ring holding means is moved by said sliding means, said wafer ring guide means taking a first position which is parallel to said guide rail and a second position which is perpendicular to said guide rail.